



सत्यमेव जयते

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## ***Industry-Academia R&D Regimes in Indian Institutes of Technology***

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## **1. Introduction**

The Industry-Academia (I-A) synergy is an indicative of the scientific innovation index of a nation. Developed countries like USA, UK, Germany, Japan and S. Korea enjoy a golden hand-shake between the academic and industrial sectors. The healthy collaboration of industry with academia is responsible for increased number of scientific innovations in these countries. India ranks third, next to USA and China, in terms of size and diversity of higher education system. However, it has not been able to accomplish the desired technological advancement (Nandi R, 2014). One the major reasons for this is attributed to the lack of, or absence of, ecosystem needed for transforming university-research into patents/technologies/processes. Out of more than 700 Higher Education Institutes (HEIs) in India, only a handful of academic institutes e.g. IITs, ICT-Mumbai and IISc-Bangalore are known for generation of patents and technologies. These institutes are also in the forefront of engaging industrial sector in its R&D programmes. In fact, IITs at Chennai, Kanpur, Mumbai, Khargapur and Delhi are considered to be the flag-bearers of I-A R&D in India. Each IIT has a dedicated academic programme (Table 1) comprising of undergraduate, post graduate and Ph.D. programmes which primarily caters to engineering domain, though biology related courses, such as biotechnology, are making inroads in these institutes. The IITs have contributed to the nation's growth and are accepted world over as the notable institutes in the domain of teaching and R&D. Table 2 lists the achievements of first generation of IITs in the different parameters of science & technology. The IITs possess almost all determinants of good I-A interface, such as I-A Cells, Intellectual Property Rights (IPR) Cell, Tech-Transfer Cell, Entrepreneurship Cell, Technology Business Incubators and so on. This chapter aims to portray the I-A regime of all the IITs existing in India.

**Table 1: Academic Programmes of First Generation IITs i.e. Established Before 2000**

<b>Attributes</b>	<b>IIT Kharagpur</b>	<b>IIT Bombay</b>	<b>IIT Madras</b>	<b>IIT Kanpur</b>	<b>IIT Delhi</b>	<b>IIT Guwahati</b>
<i>Year of Establishment</i>	1950	1958	1959	1959	1961	1994
<i>Campus Area (acres)</i>	2100	530	617.8	1055	325	700
<b>Academics</b>						
<i>Departments</i>	19	15	16	20	13	12
<i>Centres</i>	-	14*	16	27	-	08
<i>UG Students</i>	2818	7400	10,000	2255	3590	2570
<i>PG Students</i>	7612			1476	4239	1069
<i>PhDs (enrolled)</i>	616	2600	2120	-	-	1544
<i>Faculty Members</i>	600	700	614	309	459	372

\*(9 centres+4 interdisciplinary programmes +1 school of management)

**Source:** IIT Kharagpur, IIT Bombay, IIT-K, IIT-M, IIT Delhi, IIT-K, IIT Guwahati Annual Reports (2010-2015); <http://www.iitkgp.ac.in/>; <http://www.iitb.ac.in/>, <https://www.IIT-M.ac.in/>, <http://www.iitd.ac.in/>, <http://www.iitk.ac.in/>, <http://www.iitr.ac.in/>

**Table 1: Academic Programmes of Second Generation IITs i.e. Established After 2000**

<b>Attributes</b>	<b>IIT Roorkee</b>	<b>IIT Bhubaneswar</b>	<b>IIT Hyderabad</b>	<b>IIT Gandhinagar</b>	<b>IIT Patna</b>	<b>IIT Jodhpur</b>	<b>IIT Ropar</b>	<b>IIT Indore</b>	<b>IIT Mandi</b>	<b>IIT BHU</b>
<i>Year of Establishment</i>	2001	2008	2008	2008	2008	2008	2009	2009	2009	2012
<i>Campus Area (acres)</i>	356	936	567	450	501	900	525	510	520	400
<b>Academics</b>										
<i>Departments</i>	21	7 (schools)	14	13	8	8	7	11	4 (school)	13
<i>Centres</i>	12 <sup>a</sup>	3	-	-	3	2	-	-	-	3
<i>UG Students</i>	4472	164	900	123	599	NA	NA	294	400	NA
<i>PG Students</i>	2093	71(76*)	450	36	131	NA	NA	242		414
<i>Ph.Ds (enrolled)</i>	1471	48	500	2 (degrees awarded)	185	NA	NA	264	100	210
<b>Faculty Members</b>	369	125	145	150	66	53	70	70	100	265

\*Joint Msc-PhD integrated; <sup>a</sup> 1 academic centre, 3 centres of excellence, 5 academic service centres and 3 supporting units.

**Source:** [www.iitr.ac.in](http://www.iitr.ac.in), [www.iitbbs.ac.in/](http://www.iitbbs.ac.in/), [www.iith.ac.in/](http://www.iith.ac.in/), [www.iitgn.ac.in/](http://www.iitgn.ac.in/), [www.iitj.ac.in](http://www.iitj.ac.in/), [www.iitp.ac.in/](http://www.iitp.ac.in/), [www.iitrpr.ac.in/](http://www.iitrpr.ac.in/), [www.iiti.ac.in/](http://www.iiti.ac.in/), <http://www.iitmandi.ac.in/>, [www.iitbhu.ac.in/](http://www.iitbhu.ac.in/)

**Table 2: Science and Technology Indicators of First Generation IITs**

<b>IP Attributes</b>	<b>IIT Kharagpur</b>	<b>IIT Bombay</b>	<b>IIT Madras</b>	<b>IIT Kanpur</b>	<b>IIT Delhi</b>	<b>IIT Guwahati</b>
<i>Publications (2014-15)</i>	2162	~1500	1194	1298 <sup>(2014)</sup>	1300	1250
<i>Patents (2010-15)</i>						
<i>Filed</i>	231	569	239	204	146	37
<i>Granted</i>	13	>61	25	9	25	6
<i>Technology available</i>	214	409	358	6	50	05
<i>Technology Licensed (till date)</i>	24	>140	60	60	15	06
<i>Revenue generated from tech transfers (Crores ₹; upto 2015)</i>	186.80	209	461	2.38	135.83	1
<i>Incubating Companies</i>	172	71	95	52	44	13
<i>Start-ups (till date)</i>	104	>26	89	26	16	10
<i>Industrial Collaborations (MoUs; 2010-15)</i>	72	225	~176	124	8	09
<i>Corporate Clients</i>	~400	~400	227	~124	48	50
<i>Sponsored projects (Crores ₹; 2010-15)</i>	577.45 (2011-2016)	1149.95	491.11	401.23	328 (2010-2014)	220.53
<i>Revenue generated Consultancies (Crores ₹; 2010-15)</i>	69.75 (2011-2016)	143.5	251.11	52.25	138 (2010-2014)	16.37

*Source: IIT Bombay, R&D highlights 2016, Annual Reports (IIT-K) 2010-2015; Annual Reports (IIT-M) 2010-2015, Annual Reports (IIT Bombay) 2010-2015, Questionnaire filled by IITs for DST-CPR at PU, Chd., <http://www.iitk.ac.in/>, <http://www.iitr.ac.in/>, <http://www.iitb.ac.in/>, <https://www.IIT-M.ac.in/>, <http://www.iitd.ac.in/>, <http://www.iitkgp.ac.in/>, <http://www.iitg.ac.in/>, External Peer Review committee Report (IIT Delhi -2015), External Peer Review committee Report (IIT Kharagpur -2015).*

## 2. Industry – Academia R&D Activities of IITs

### I. Indian Institute of Technology, Kharagpur (IIT-KGP)

(<http://www.iitkgp.ac.in/>)

**Introduction:** IIT-KGP was the first IIT to be established in 1950 in Kharagpur, West Bengal. The institute published close to 2100 research articles in the academic year 2014-15. In the last five years, the institute has filed over 230 patents, out of which 15 patents have been granted. 214 technologies are available to be commercialised and ~25 have been licensed, generating a revenue close to ₹186 crores. The institute has 72 industrial collaborations (2010-15), ~ 400 corporate clients, 172 incubatees and 104 start-ups till date. In the last five years (2011-16), IIT-KGP has earned close to ₹ 76 crores from consultancy projects and ₹ 577 crores from sponsored projects.

#### *Industry Related Programmes*

- a) **Sponsored Research & Industrial Consultancy (SRIC)** (<http://www.ttg-sric.iitkgp.ernet.in/sric/>): To monitor the high volumes of sponsored research and consultancy projects, SRIC was initiated in 1982. The centre has well built infrastructure and the capacity to handle approx. 700 R&D projects at a time. Under the aegis of SRIC, the institute has set up an IPR and Industrial Relations Cell to look after the interests of faculty, funding agencies and industry partners. Currently, SRIC cell has 773 on-going research projects. In the last five years, the total funds received by IIT-KGP were over ₹ 630 crores through more than 1500 research and consultancy projects.
- b) **Technology Transfer Group** (<http://www.ttg-sric.iitkgp.ernet.in/ttg/research.php>): This is an initiative of the students under the aegis of SRIC. The main objective of this group is to act as a link between the academia and the industry to facilitate the transfer of technologies (industry-ready) developed at IIT-KGP and to market the intellightsia of the institute as a research consultant. The services offered by this group includes:
- *Consultancy:* Industry or any external agency can approach the institute for problem solving.
  - *Technology Assessment:* Helps in assessment of existing processes/ technologies to reach upon possible areas for improvement.

- *Research Lab Services*: The *state of art* laboratories with avant-grade instruments and skilful research staff cater for technology evaluation, lab based testing and analysis, and research collaborations.
- *Expert Access*: The large pool of highly accomplished scientists and researchers can be contacted for consultancy on key technical areas.
- *Know-how Transfer*: This group is responsible for research reports/ publications, procedures, protocols, formula, designs/ drawings and any other information with regard to a particular technology, product and process.
- *Product Design*: This service brings together various partners for idea generation, concept development, testing, and implementation thereby converting the ideas into final commercial entity.

The Technology Transfer group has also initiated **IndAc**, a confluence of industry and academia. It provides platform to the industry to present their needs and to the academia for showcasing itself as a research consultant.

c) **The Science and Technology Entrepreneur's Park-Technology Business Incubator (STEP-TBI)** (<http://www.step-iit.org/>): STEP at IIT-KGP was established in 1986 with financial support from DST, IDBI, IFCI and ICICI. STEP has created conducive surroundings to nurture and guide entrepreneurial efforts. It has led to number of technology transfers and successfully converted research outcomes to commercially viable entities. STEP works in unanimity with the other programmes like Technology Business Incubation (TBI) and Technology Incubation and Entrepreneurship Training Society (TIETS). It acts as a pipeline amid the institute and the world outside to enable facilitation of transfer of technology along with conversion of research outcomes of entrepreneurs into commercially viable entities.

STEP-TBI gets funding support through various schemes of GoI such as Promoting Innovations in Individuals Start-ups and MSME (PRISM), Technology Incubation and Development of Entrepreneurs (TIDE) scheme and Technology Development Board (TDB).

➤ **Technology Incubation and Entrepreneurship Training Society (TIETS)** ([http://www.step-iit.org/about\\_tiets.html](http://www.step-iit.org/about_tiets.html)): This society was created in the year



2006 and seeded the efforts to create infrastructure to trigger the generation of entrepreneurship, idea generation, incubation and integration amongst students and alumni. TIETS has created an avenue for incubates where they get fund support, mentoring and prototype branding. It works in close association with STEP.

- **Entrepreneurship Cell (E-Cell)** (<http://www.ecell-iitkgp.org/index.php>): This non-profit organization, run by the students, is dedicated to the cause of boosting entrepreneurship among students. The Cell acts as a forum to provide opportunity for students entrepreneurs to trial their idea with the help of TIET and STEP. It has also led to the design of courses and training programmes for IIT stakeholders and public in general. E-Cell organizes various patent workshops, case study workshops and knowledge camps to promote entrepreneurship among students. It has successfully linked investors with the entrepreneurs.

**d) Technopreneur Promotion Programme (TePP) Outreach cum Cluster Innovation Centre (TOCIC)** (<http://www.step-iit.org/TePP.html>): With the initiatives of DST and DSIR, TOCIC was started in 2014 for promoting independent innovators and transforming them into entrepreneurs by facilitating them with government grants, mentoring and technical guidance through academic and industry experts.

**e) Telecom Centre of Excellence (TCOE)-Vodafone IIT Centre of Excellence in Telecommunications (VICET) at IIT-KGP:** Established under PPP mode in 2007, VICET is one of the successful examples of government Dept. of Telecommunication), academia (IIT-KGP) and industry (Vodafone) Ltd.). The main research of VICET is “Next Generation Networks and Technology”.

<b>Examples of a few technologies developed, patents and MoUs signed by IIT-KGP in 2015-16</b>	
<b>S. No.</b>	<b>Technologies Developed</b>
1.	Venucane: An electronic travel aid for visually impaired and blind people

2.	Ultrafiltration membrane for cold sterilization of bottle gourd juice ( <i>Lagenaria siceraria</i> ) for extended shelf life and method thereof	
3.	Ultra-sensitive simultaneous electrochemical determination of arsenic, mercury and copper	
4.	Surveillance using partial gait sequences of a human being	
5.	Purification of lactic acid and its polymerisation to polylactic acid with improved property	
6.	Non-invasive blood glucose measuring system	
<b>S. No.</b>	<b>Patents</b>	<b>Application Number</b>
1.	A low complexity generalized frequency division multiplexing transceiver	1018/KOL/2015
2.	A micro-reactor based energy efficient process for cellulosic ethanol production	961/KOL/2015
3.	Stable hybrid polymer adapted for superhydrophobicity and process for manufacture thereof	758/KOL/2015
4.	Reconstituted rice grains and its process of manufacture	699/KOL/2015
5.	A precoded generalized frequency division multiplexing system to combat inter symbol interference and reduce peak to average power ratio	453/KOL/2015
6.	An adverse environmental effect resistant seamless wireless sensor network system.	425/KOL/2015
<b>S. No.</b>	<b>MoU with Industry</b>	<b>Signed with</b>
1.	MoU with Hindustan Aeronautics Limited (HAL), Bangalore.	Hindustan Aeronautics Limited (HAL)
2.	MoU with SAP Lab India Doctoral Fellowships	SAP Lab India

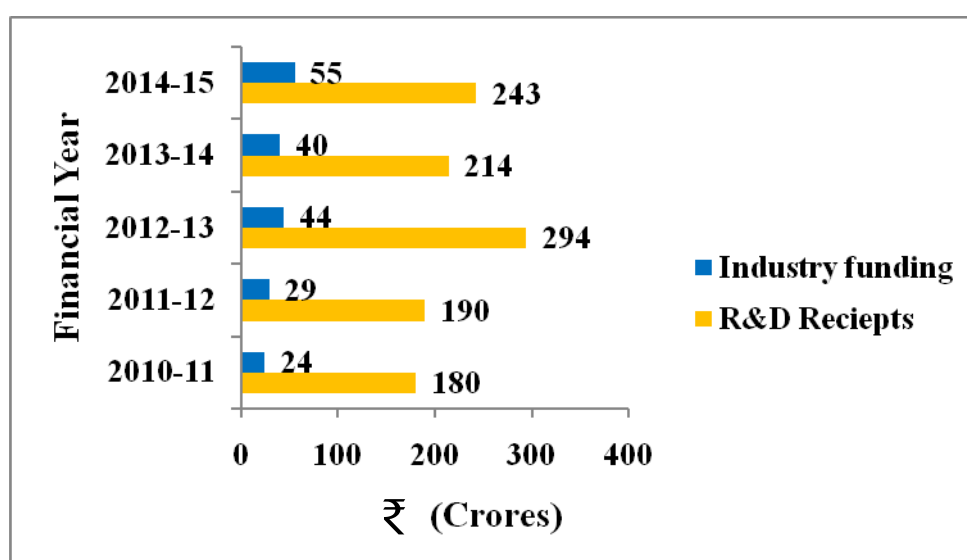
Source: <https://www.iitsystem.ac.in/>

## II. Indian Institute of Technology, Bombay (IIT-B)

(<http://www.iitb.ac.in/>)

**Introduction:** IIT-B was the second of its kind and established in the year 1958 in the western part of the country. This was the first institute to be established with the aid of foreign funds provided by UNESCO.

Since its inception, institute has received huge amount of R&D funds from both national and international organizations and industrial segment. Government funding accounts for ~70% where as industry funding accounts for ~21% (IIT-B, Industry Interaction Flyer 2016). The financial insight to the R&D funding of IIT-B in last five years is depicted in figure 1



**Figure 1: R&D Funding in IIT-B (2010-15)**

*Source: IIT-B Annual Report 2014-15*

To set a benchmark in research directed towards industrial growth, IIT-B has established various centres. IIT-B has over 1500 publications in the academic year 2014-15. In the last five years, the institute has filed ~570 patents of which nearly 60 patents have been granted. An astounding increase in the number of patent filings was witnessed e.g. in 2010, 46 Indian patents were filed from IIT-B. The number rose to 102 in year 2015. IIT-B is credited with National Intellectual Property Award (2015) and Thomas Reuters India Innovation Award (2014) due to its enhanced role in country's R&D development.

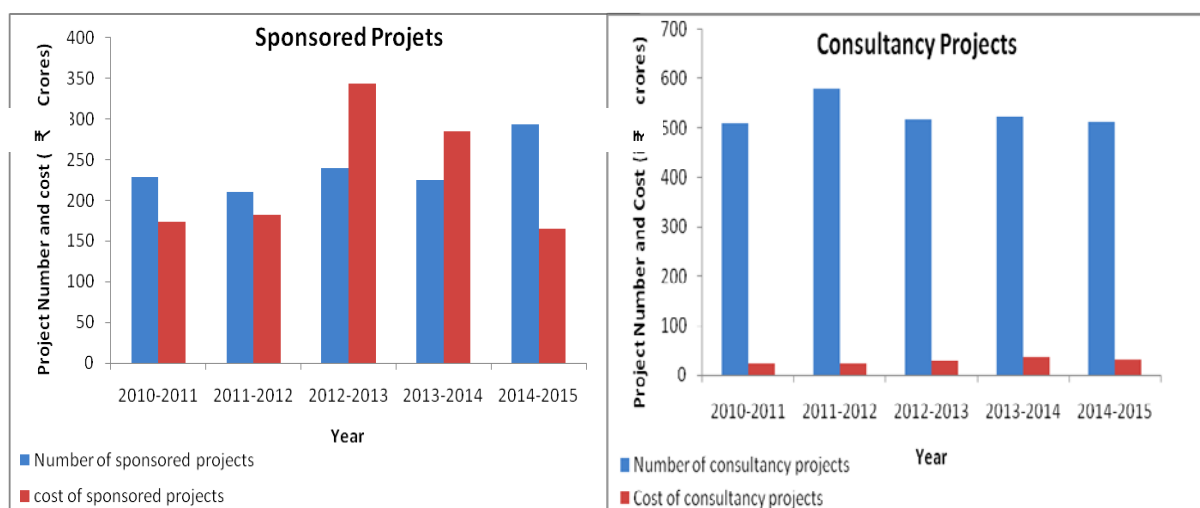
IIT-B is actively involved in translating its research into commerce through licensing and start-ups. The institute has about 400 technologies that are ready for transfer/licensing and approx. 140 technologies have been licensed till date, which have generated total worth close to ₹ 210 crores. To bolster I-A interactions, it has signed 225 MoUs with various industrial

organizations. It has approx. 400 corporate clients, 71 incubatees and > 25 start-ups till date. IIT-B, in the last five years, has drawn ~ ₹ 140 crores and ~ ₹ 1150 crores from consultancy and sponsored projects respectively.

### *Industry Related Programmes*

**a) Industrial Research and Consultancy Centre (IRCC)**

(<http://www.ircc.iitb.ac.in/IRCC-Webpage/rnd/index.jsp>): The centre set up in 1975, facilitates and co-ordinates all R&D activities of the institute. The centre aids in generating and protecting the IP of the institute, and their deployment for economic development through commercialisation. It is involved in facilitating short term projects to solve industrial problems as a consultancy projects (~2690 consultancy projects in past 5 years worth ₹ 144.5 crores) or industrially/government sponsored fully fledged long term technology development projects (~1198 sponsored projects in past 5 years worth ₹ 1149.95 crores) (Fig. 2). All the research funding and interaction of the institute with the industries/ private sector are managed under the umbrella of IRCC.



**Figure 2: Number of Sponsored and Consultancy Projects and the Revenue Generated Through Them**

*Source: IIT-B Annual Report 2014-15*

Under the aegis of ‘Industry Partnership Scheme’ industry sponsored labs have been set up where industry and IIT-B faculty can jointly undertake project work. Select major industry-sponsored laboratories set up in recent years include:

- Xilinx FPGA Laboratory
- The Tata Infotech Laboratory

- Intel Microelectronics Laboratory
- Laboratory for Intelligent Internet Research
- Tata Consultancy Services Laboratory for VLSI Design and Device Characterisation
- Texas Instruments Digital Signal Processing (TI-DSP) Laboratory
- Wadhvani Electronics Laboratory
- Cummins Engine Research Laboratory
- Applied Materials Nano Manufacturing Laboratory
- VLSI Design Consortium

In addition, various consortia groups of IIT-B-government-industry, under PPP mode have been established. These consortia are as following:

- Centre of Excellence in Telecom
- Healthcare Research Consortium
- Industry Affiliates Program at the National Centre for Photovoltaic Research and Education (NCPRE)
- National Centre for Aerospace Innovation and Research
- National Solar Thermal Power Research Testing and Simulation Facility

The relations of IIT-B with the industry are such that the industry may also sponsor a student in the field of their interest and some of the industries that have sponsored students of IIT-B are Konecranes, Areva, TCS, Infosys and Intel. Along with this, around 20 Chair Professorships have been established at IIT-B by both the alumni and the industries e.g. TATA Chair, Praj Industries Chair, Forbes Marshall Chair and Bajaj Group Chair in order to promote I-A collaborations and industry participation in academics.

IIT-B has upheld the social responsibility very well by contributing to both urban and rural community by means of technology based solutions under the Centre for Technology Alternatives in rural areas. IIT-B has led to the development of various technological advancements especially for rural areas like development of dry sanitation system, dhoop stick making machine, bore recharge system, water storage system of natural fibres, low cost check dams and herbal oil extraction unit. IIT-B

also designed the symbol of Indian Rupee (₹) which is now the official Indian currency symbol used globally (IIT-B, R&D Highlights 2016).

In the year 2014, under IRCC, a **Research Park** was established in IIT-B with financial support from the MHRD. Research Park provides an ecosystem where academia and industry/ research fraternity can work in close collaboration on research problems, product innovation and technology challenges. IRCC has also released revised Intellectual Property (IP) policy of IIT-B and takes care of licensing of IP developed by IIT-B.

**b) Society for Innovation and Entrepreneurship (SINE)**

(<http://sineiitb.org/sine/home>): SINE was established in 2004 with the support from IIT-B alumni. SINE is a platform for promotion of entrepreneurship and administers business incubator that supports technology based entrepreneurship. It maintains a support system for knowledge based start-ups founded by IIT community thereby leading to creation of wealth and social upliftment. Till date it has incubated 64 companies, 38 companies have graduated and 19 incubatees are residents of SINE. It has generated more than 1500 jobs (IIT-B, R&D Highlights 2016). SINE also manages a TBI at IIT-B.

**c) The Desai Sethi Centre for Entrepreneurship (DSCE)**

(<http://www.iitb.ac.in/dsce/en/about>): It was established in 2013 in collaboration with Desai Sethi foundation. It aims in spurring entrepreneurship in the campus by introducing various entrepreneurship academic programmes. It has initiated 'Proof of Concept Centre' (PoCC) to support students to convert their ideas into tangible products through performance management, validation facilities and rapid prototyping. It also supports budding entrepreneurs through micro-grants and mentoring.

**d) The Entrepreneurship Cell (E-Cell)** (<http://www.ecell.in/2015/>):

It is non-profit organization of students initiative in which regular workshops, innovative games, speaker sessions, competition for aspiring entrepreneurs, provides financial resources such as seed funding, networking and consultancy for budding student entrepreneurs. It has led to various initiatives that support the upcoming student start-ups. These initiative are as:

- Freelancers and Co-founder Platform (FCoF)

- E-summit
- Eureka road to enterprise
- National Entrepreneurship Challenge (NEC) in association with Lenovo
- Entrepreneurship and Business (ENB) Club
- Start-up Services Platform (SSP)

The vision behind these initiatives was to build a strong and flexible ecosystem in the organization for allowing the expansion of knowledge according to the changes in the socio-economic needs of the society.

**e) Tata Teleservices IITB Centre of Excellence in Telecommunications (TICET):**

This centre was established under the PPP mode in 2007 vide signing of an MoU between DoT, GoI, IIT-B and Tata Teleservices Ltd. The main focus area of the TCOE at IIT-B is “Rural Telecom Technology”. The TCOE has been set up with an aim to create novel services/ applications, develop global level manufacturing capability, generation of intellectual property, entrepreneurship and will meet the challenges that have been faced by the telecom industry in India.

IIT-B in its quest for dispersing knowledge and to deliver this knowledge to the society, engages in several activities to interact with local and global organizations. Its major activities include:

- **Continuing Education Programme (CEP):** Short, intensive courses for working professionals in industry or government, for enhancing expertise in their respective fields. In house courses are also conducted for special training of a particular group according to the needs of a particular industry.
- **Quality Improvement Programme (QIP):** This programme was launched by the GoI in 1970, to upgrade the faculty of other institutions. QIP enables them to obtain Master’s and Doctoral degrees.
- **Centre for Distance Engineering Education Programme (CDEEP):** CDEEP intends to provide distance education through different media such as video recordings of classroom lectures, web-based courses, live interaction and so on. The prowess of IIT-B’s faculty is freely available for learners everywhere. The courses that the institute offers through their

distance education programme are the same as the ones taken by the students of IIT-B.

IIT-B, since its initiation, has reaped huge benefits from its locale, which is one of the largest industry-intensive area's in India. The R&D activities of the institution have been largely governed and promoted by its geographical location.

<b>Examples of a few technologies developed and patents by IIT-B in 2014-15</b>		
<b>S. No.</b>	<b>Technologies Developed</b>	
1.	Supercritical fluid extraction system design for extraction of food flavours, additives and medical components	
2.	Palletized tea storage methodology employing controlled atmosphere	
3.	Vermiculture technology for solid and liquid waste management	
4.	Graphs theoretic algorithms for automatic index determination of differential algebraic equations	
5.	Design analysis and simulation of batch distillation and pressure swing adsorption units.	
<b>S. No.</b>	<b>Patents</b>	<b>Application Number</b>
1.	A method and a system for producing thermolabile nanoparticles with controlled properties and nanoparticles matrices made thereby	2213/MUM/2011
2.	A solar cell having three dimensional junctions and a method of forming the same	3467/MUM/2010
3.	Electrodiagnostic equipment	Patent application no. 14/MUM/2001 Patent grant no. 206022
4.	A diagnostic method for determining deformations in a transformer or reactor winding	Indian patent application no. 1893/MUM/2007 US patent Grant no. 8,278,939

*Source: IIT-B Annual Report 2014-15*



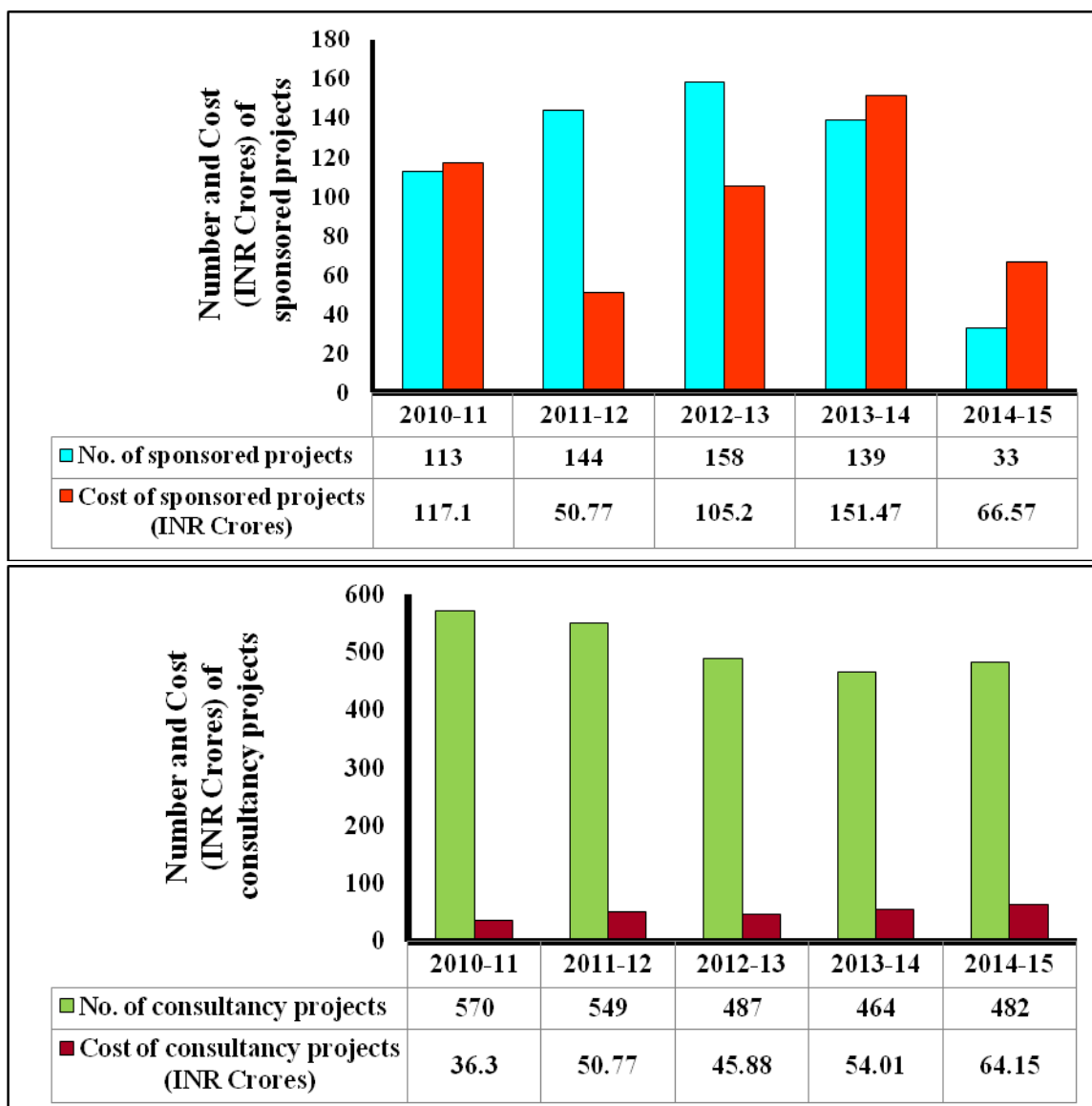
### **III. Indian Institute of Technology, Madras (IIT-M)**

*(<https://www.iitm.ac.in/>)*

**Introduction:** IIT-M was established in 1959 with partial assistance from West Germany, which provided for services of experts, foremen, training facility and the supply of equipment for setting up 20 laboratories and a central workshop at IIT-M. Amongst all IITs, IIT-M leads in the industrial collaborations and functioning in industry-funded projects. IIT-M published over 1100 research articles during 2014-15. Out of 239 patents filed in the academic years 2010-15, 25 have been granted. The institute has approx. 350 technologies ready to be licensed and 60 have been licensed till date, which have generated a worth of ₹ 461 crores. Further, the institute is emerging as one of the most vibrant start-up hub of the country. Till date, a total of 89 start-up companies have been incubated in IIT-M and 95 are present incubatees. The institute has signed MoUs with close to 175 industries and has 227 corporate clients. In the last five years (2010-15), IIT-M has undertaken sponsored projects worth ₹ 491 crores and has generated ₹ 251 crores from consultancy projects.

#### ***Industry Related Programmes***

- a) **The Centre for Industrial Consultancy and Sponsored Research (IC&SR)**  
(<https://www.IIT-M.ac.in/icsr>): Established in 1973, this centre aims to promote interaction between the industry and the institute facilitating sponsored and consultancy projects. It holds the responsibility for industrial collaboration in terms of research and consultancy, technology licensing and intellectual property related issues. Today, the centre for IC&SR stands as an independent section of the institute. It has initiated the industrial association scheme to attract industrial sectors and at present hosts 227 industries under this scheme. IC&SR facilitated the emergence of number of centres for excellence in the institute and also taken up sponsored and consultancy projects worth crores of rupees as depicted in figure 3.

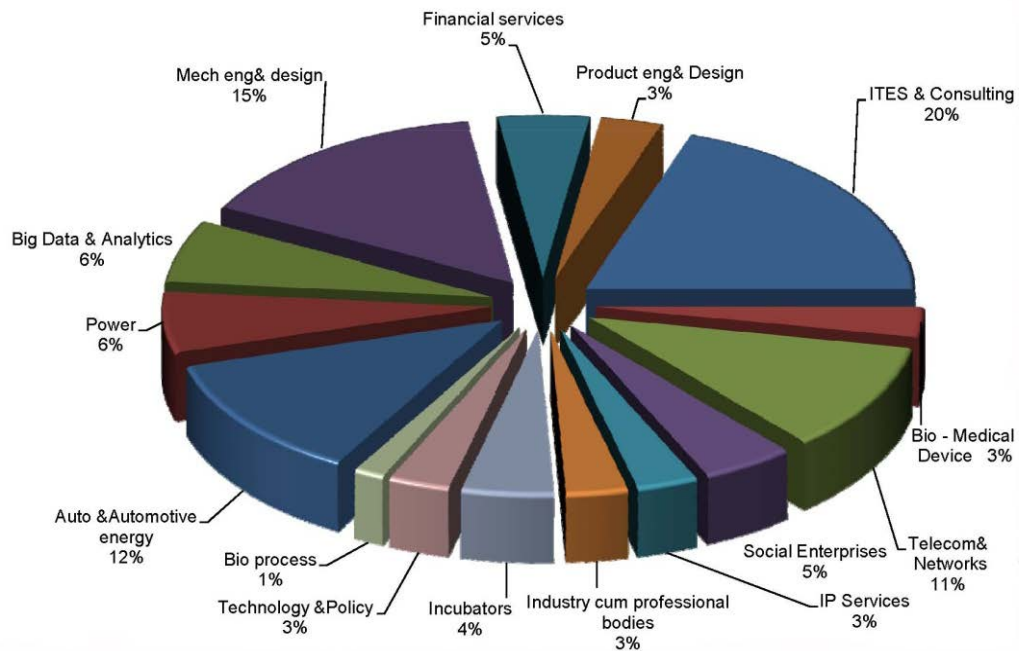


**Figure 3: Number and Cost of Sponsored and Consultancies Projects Carried Out in IIT-M**

*Source: IIT-M Annual Report 2014-15*

**b) IIT-M Research Park** ([http://respark.IIT-M.ac.in/about\\_us.php](http://respark.IIT-M.ac.in/about_us.php)): The Research Park at IIT-M is one of the most accomplished set up in the country. It is an independent company promoted by IIT-M and its alumni registered under Section 25 (now Section 8 of Companies Act 2013) of Companies Act 1956 and is India's first university driven research park. It facilitates promotion of R&D in partnership with industry, generation of new ventures and promoting rural economic development. IIT-M Research Park assists newly formed companies with a research focus to set up base in IIT-M Research Park and provides expertise of IIT-M to develop knowledge and innovation ecosystem. It contains more than 30 corporate clients from various

different segments as depicted in figure 4. The golden triad of industry, faculty and students working together has generated many successful innovations.



**Figure 4: Industrial Sectors in Collaboration with IIT-M in IIT-M Research Park**

*Source: [http://respark.IIT-M.ac.in/about\\_us.php](http://respark.IIT-M.ac.in/about_us.php)*

- c) **IIT-M Incubation Cell** (<http://www.incubation.IIT-M.ac.in/>): It aims to synergize and coordinate innovation, entrepreneurship and facilitating industrial interactions. It is working in the field of industrial solutions, rural technologies and social impact. It supports creation of ecosystem for R&D development including staff, students, alumni, faculty, industry and R&D partners in creation of successful ventures. It has also been registered under Section 8 of the Companies Act 2013 and recognized as a TBI by NSTEDB. In totality, 94 incubatees have been incubated in the IIT-M incubation cell and more than 50 companies converted to successful ventures. IIT-M incubation cell taps vast faculty and alumni network to provide mentoring support associated with IIT-M entrepreneurship forum specifically designed to help entrepreneurs to move in direction from business idea to actual start up.

The IIT-M incubation cell has also launched the **Entrepreneur-in-Residence programme** where current incubatees can avail unique opportunity to interact one-on-one with accomplished entrepreneurs. It has further nurtured several incubators which were established for specific sectors like:

- **The Rural Technology Business Incubator (RTBI)** (<http://www.rtbi.in/>) was set up in 2006 in association with World Bank's Infodev project and DST. Major focus area of RTBI is rural and social development. It has incubated over 41 companies and has graduated 14 successful start-ups which work for solving some of the rural India challenges such as water, food, power and education.
- **Bio-incubator** (<http://www.bioincubator-IIT-M.in/>) was established by BIRAC under Bio Incubator Support Scheme (BISS) and aims to foster Indian biotech entrepreneurship and innovation enhancing R&D capabilities of SMEs, MSMEs and start-ups. It offers space, high-end equipments, research facilities, scale-up facilities, technical support and financial assistance to researchers with nascent ideas to transform into commercialized process/product. It contains 24 corporate clients and has incubated 11 companies.
- **The Cell for Technology Innovation, Development and Entrepreneurship Support (C-TIDES)** (<http://www.c-tides.IIT-M.ac.in/>), started in 1998, also named as Entrepreneurship Cell, is a core for student entrepreneurship activities in IIT-M to promote student led entrepreneurship and pre-incubation support.

IIT-M has recently adopted business incubation policy to set guidelines for coordination of growing entrepreneurial culture in IIT-M. IIT-M incubation cell specifically holds responsibility of implementing the policy effectively.

- d) **Reliance IITM Centre of Excellence (RITCOE):** RITCOE was founded in 2007, when an MoU was signed between DoT, GoI, IIT-M and Reliance Communications Ltd. This centre, which focuses on "Telecom Infrastructure and Energy" was established with an aim to position India as a global telecom manufacturing hub and along with other CoE aims to cope up with the problems that the telecom industry faces.
- e) **The Centre for Innovation (CFI)** (<http://cfi.IIT-M.ac.in/main/>): CFI was founded with funds donated by the alumni of the 1981 batch and is a student lead body. The CFI provides for infrastructural support, and guidance nurture innovation in engineering.

- f) **The Centre for Social Innovation and Entrepreneurship (CSIE)** (<http://csie.IIT-M.ac.in/>): Founded in 2010 this centre works towards developing the social enterprise in India by focusing on teaching and research in the said domain.
- g) **IIT-M Entrepreneurship Forum**: The IIT-M Alumni Association initiated this forum to bring about awareness and promotion of entrepreneurial activeness amongst the other IIT members. This forum intends to contribute by providing the students with a culture/apprenticeship in start-ups and tutorship.

IIT-M, in its future activities, is planning a large project on contemporary manufacturing, focusing on virtual technologies and sustainability. Over the next decade, the success of these projects could become important for laying the foundation for a competitive technology industry.

<b>Examples of a few technologies developed and patent by IIT-M in 2015-16</b>		
<b>S. No.</b>	<b>Technologies Developed</b>	
1.	A steering/seat assembly for monitoring and alerting a driver based on his/her fatigue and/or behavior	
2.	Boss mool lab	
<b>S. No.</b>	<b>Patent</b>	<b>Application Number</b>
1.	A method of measuring the air-fuel ratio of a spark ignition engine	3194/CHE/2008

*Source: <https://www.iitsystem.ac.in/>*

#### **IV. Indian Institute of Technology, Kanpur (IIT-K)**

*(<http://www.iitk.ac.in/>)*

**Introduction:** IIT-K was established by GoI in the year 1959 under “The Kanpur Indo-American Programme”. The institute received technical assistance from a group of top nine institutes of USA. IIT-K has emerged as an institute that has excelled in education and research activities in tune with the needs of the society. IIT-K has close to 1300 research publications in the year 2014-15. In the last five years, 204 patents were filed from the institute out of which 9 patents have been granted. IIT-K presently has 6 technologies ready

to be transferred and the institute has already licensed 60 technologies, resulting in earnings of ₹ 2.38 crores. With 52 incubatees and 26 start-ups till date the institute has been promoting innovation and entrepreneurship actively. IIT-K has generated ₹ 52.25 crores and ₹ 401 crores from consultancies and sponsored projects respectively. It has close to 124 corporate clients and has signed MoUs with approx. 120 industrial organizations.

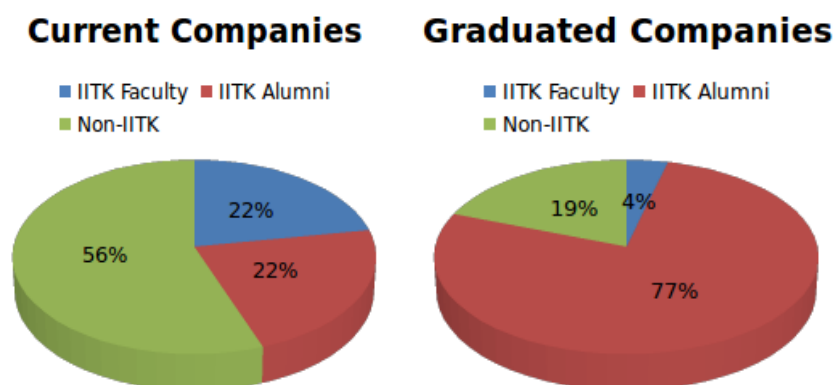
### ***Industry Related Programmes***

**a) SIDBI Innovation and Incubation Centre (SIIC)**

(<http://www.iitk.ac.in/siic/d/about-siic>): Set up at IIT-K in collaboration with Small Industries Development Bank of India (SIDBI), SIIC, fosters innovative research and activeness in entrepreneurship, in technology related fields/areas. It was established in 2000 with the perception of being able to transform the knowledge of the institute into wealth. The centre has a twofold vision; the vision statements are:

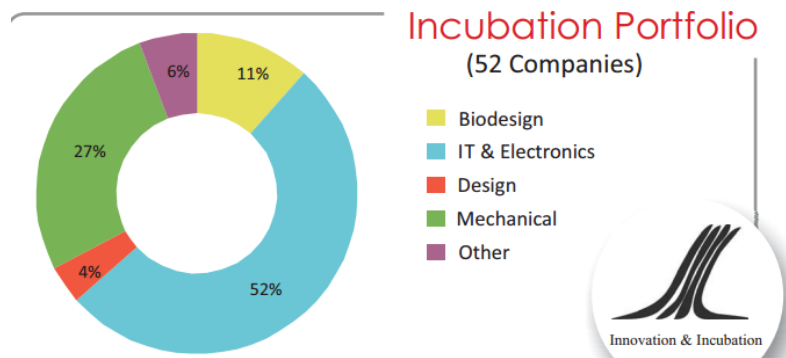
- To create a generation of zealous entrepreneurs.
- To convert novel research into valuable intellectual property.

For IIT-K, SIIC acts as a single platform for agendas in regard to innovative research, development and commercialization of technology, incubation, entrepreneurship etc. The profile of incubating and graduated companies is presented in figure 5 and 6.



**Figure 5: Pie Chart of IIT-K for Current Incubates and Graduated Companies**

Source: <http://www.iitk.ac.in/>



**Figure 6: Sector Wise Incubation Portfolio of IIT-K**

*Source: <http://www.iitk.ac.in/>*

So far, SIIC has successfully:

- Incubated and mentored ~52 companies.
- Disbursed seed funds of ₹ 50 crores.
- Collaborated with organizations like NEN, SUM, IIMA.
- Commercialized 56 patents (worth ₹ 2.38 crores).
- Sponsored projects (2010-2015) = 619
- Consultancy projects (2010-2015) = 451

#### **Major Activities of SIIC Include -**

**i. Incubation:** A whole spectrum of incubation related facilities and other services are provided by SIIC to the eventual entrepreneurs and also help the entrepreneurs realize the conversion of their novel ideas into commercially viable results. The incubatees at SIIC explore different domains such as, scientific know-how, engineering and other integrative areas. The centre has gained a decent visibility and developed a fine interface through events like the entrepreneurial talk series, conferences, workshops and seminars that it has been hosting/organizing. Today, SIIC is one of the most prestigious incubators in India and it has grown tremendously since its initiation in 2003. From one incubation centre, representing IIT-M, SIIC has evolved to being seven centres representing various arms of government. It acts as a:

- SIDBI Innovation and Incubation Centre (for SIDBI)
- Technology Business Incubator (for DST)
- MSME Incubator (for MSME)
- Technology Incubation & Development of Entrepreneurs (for MIT)

- Technology Entrepreneurship Promotion (for DSIR)
- Bio-Incubator (for DBT)
- MoLE Incubator

**ii. Patenting:** The IIT-K faculty members and disciples take professional aid from SIIC, for filing of IP (patents, copyrights etc.). Thus, the centre also acts as Technology Transfer Office (TTO) of the institute. So far, the centre has been responsible for filing more than 264 patents for the IIT-M faculty and students. In collaboration with a commercial partner; to meet the needs of the industry, this centre facilitates up-gradation/modification of the technology developed at the institute, so that the technology is ready for the market. The faculty member related to development of the technology acts as a mentor for the same. Marketing of the product and customer support are the responsibilities taken up by the commercial partner. SIIC also has strategic alliances with organizations like National Entrepreneur Network (NEN), Singapore Management University (SMU), IIM Ahmedabad and others. SIIC, in collaboration with these organizations, regularly holds workshops and trainings to promote entrepreneurship.

**b) Knowledge Incubation for Technical Education Quality Improvement Programme (TEQIP)** (<http://www.iitk.ac.in/tkic/teqip.html>): The centre acts as a nodal archive for all the emerging academic knowledge, along with being a platform for teacher training activities and knowledge up-gradation of the students.

The objectives of TEQIP are:

- Strengthening institutions to produce high quality engineers for better employability
- Scaling-up postgraduate education and demand-driven R&D and innovation
- Establishing 'Centres of Excellence' for focused applicable research
- Training of faculty for effective teaching
- Enhancing institutional and system management effectiveness

**c) TePP Outreach cum Cluster Innovation Centre (TOCIC)** (<http://www.iitk.ac.in/siic/d/article/siic-becomes-tepp-outreach-centre>): As a new



initiative during 1998-99, the Ministry of Science and Technology, GoI, launched a novel programme known as "Technopreneur Promotion Programme" (TePP) jointly operated by DSIR and TIFAC of the DST to highlight and bring out the boundless amounts of novel and innovative ideas of the nationals of the country. TePP is an initiative to bolster innovators and transform them into technology-based entrepreneurs (Technopreneurs).

The objectives of the TePP are:

- Promote and support untapped creativity of individual innovators.
- Assist the individual innovators to become technology based entrepreneurs.
- Assist the technopreneur in networking and forging linkages with other constituents of the innovation chain for commercialization of their developments

**d) National Centre for Flexible Electronics (FlexE):** This centre was set up in the year 2014, with the grant from DeitY, under the ESDM scheme of Electronics Policy 2012 of GoI. The FlexE Centre provides a platform for meaningful interactions amongst the industry and the academia. The main objectives of the centre include:

- *Research & Development:* Scientific investigations and studies in the field of flexible electronics.
- *Manufacturing:* Developing partnership with the industry to conduct research with a view of taking it to the manufacturing level.
- *Ecosystems:* Facilitating formation of a conducive ecosystem for both the industry and the academia by addressing aspects such as materials, machinery, links with reputed national and international centres.
- *Entrepreneurship:* Scope for incubating small scale industries in the field of flexible electronics.
- *International Partnerships:* Develop strategic partnerships to aid accelerated product development cycle.
- *Human Resources:* Development of human resources for the relevant expertise.

- e) **BSNL IITK Telecom Centre of Excellence (BITCOE):** Another CoE, under the PPP mode was established at IIT-K. An MoU signed between the DoT, GoI, IIT-K and Bharat Sanchar Nigam Ltd. founded this centre. The setting up of TCOE is a big initiative wherein the govt., academia and industry are working collaboratively and the biggest telco's of India have joined hands as principal sponsors. The main focus area of this centre is 'Multimedia & Telecom, Cognitive Radio & Computational Mathematics'.

<b>Examples of a few technologies developed, patents filed and MoUs signed by IIT-K in 2014-15</b>		
<b>S. No.</b>	<b>Technologies Developed</b>	
1.	Design and fabrication of autonomous flapping wing unmanned air vehicle for surveillance and aerial photography	
2.	Development of autonomous rotary unmanned aerial vehicle (RUAV) in 10 kg weight	
3.	Opto fluidic optical lens and lens filter system	
4.	Comprehensive air sampling device	
5.	Water purification filter	
6.	Laser-facilitated synthesis of metal	
<b>S. No.</b>	<b>Patents</b>	<b>Application Number</b>
1.	An instrument for tonic note selection & voice range determination for Indian music singer	1272/DEL/2014
2.	Remote monitoring and control for power system network using mobile SCADA application	1322/DEL/2014
3.	Coiled carbon nanomaterial coated carbon fiber reinforced high performance polymer nanocomposites for structural applications and method of manufacturing the same	1331/DEL/2014
4.	Compact air cooler using nano-structured surfaces	3246/DEL/2014
<b>S. No.</b>	<b>MoUs with Industry</b>	<b>Signed with</b>
1.	To design and develop computer programming course	IREO Private Limited, New Delhi
2.	Experimental evaluation of textile reinforcement for seismic strengthening of masonry infills.	Saint Gobain Research India, Chennai

3.	Development of high strength highly ductile low carbon alloy multiphase steels for structural applications.	Tata Steels Ltd., Mumbai
4.	Conducting the CODE competition.	Hindustan Unilever Limited, Mumbai

*Source: <https://www.iitsystem.ac.in/>*

## V. Indian Institute of Technology, Delhi (IIT-D)

*(<http://www.iitd.ac.in/>)*

**Introduction:** IIT-D was established in 1959 by GoI in collaboration with the British Government. Strong industrial links have been maintained by the faculty of the institute by means of consultancy assignments. These assignments include various aspects like process and product development, troubleshooting, parameter checks etc. In addition to these activities, the faculty members of the institute also hold short-term training programmes that are company specific. To achieve enhanced industrial participation in the engineering education, the institute has taken an initiative to start with a masters degree programme which will be sponsored by the industry. It has dedicated centres to provide specific administrative and directorial aid for industry sponsored and consultancy projects and related R&D activities and has earned huge revenues of approx ₹ 0.36 crores from I-A interface. In the year 2014-15, there were 1300 research publications from the institute. From the year 2010 to 2015, the institute filed 146 patents, of which 25 were granted. Till date 15 technologies have been licensed by the institute generating worth amounting nearly to ₹ 135 crores and 50 are ready to be transferred/ licensed. The institute earned ₹ 328 crores and ₹ 138 crores from sponsored projects and consultancy projects respectively (2010-14), generated 16 start-ups and has 44 incubatees presently. In the last five years, IIT-D has signed eight MoUs with industries.

### *Industry Related Programmes*

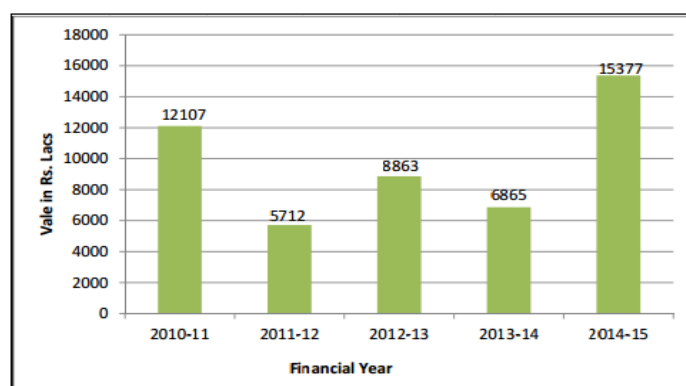
#### a) **The Industrial Research and Development (IRD)**

(<http://ird.iitd.ac.in/content/about-ird/>): The IRD unit is responsible to provide administrative backing and management for the varied types of projects that are undertaken by the faculty of IIT-D. Through IRD, IIT-D has laid strong emphasis on sponsored research and industrial interactions (Fig. 7). It has contributed to solving industrial problems relevant to the need of the country. IRD has initiated various

industry sponsored master degree programmes to enhance industrial participation in R&D and engineering education. Main area for which IRD is working:

- Sponsored research projects (high impact projects)
- Consultancy jobs
- Professional development fund
- Intellectual property rights
- Sponsored fellowships
- Industry sponsored M. Tech programmes

Financial Year	Sponsored Research Projects	
	Numbers	Sanctioned Value (Rs. Lacs)
2010-11	130	12107
2011-12	123	5712
2012-13	142	8863
2013-14	150	6865
2014-15	164	15377



**Figure 7: Sponsored Research Projects Undertaken Under IRD (2010-15)**

*Source: <http://ird.iitd.ac.in/IRD/Highlights.pdf>*

b) **Foundation for Innovation and Technology Transfer (FITT)** (<http://www.fitt-iitd.org/>): FITT was established in 1992 as a registered society. It is one of the most successful industrial interface organizations in the country. It aims to foster, encourage and build-up commercialization of R&D in IIT-D for mutual memberships. It has grown as self sustaining centre having numerous financial reserves in form of ₹ 0.36 crores in year 2015. FITT itself consists of number of services that are involved in innovation, technology and product development in collaboration with number of industries and generation of entrepreneurs and start-ups. Services offered by FITT are as following:

- Information support service to industry and R&D organisations

- Transfer of technology relating to proven R&D outputs
- Research partnership with industry for technology development and its commercial applications
- Innovative problem solving consultancy with industry clients.
- Industrial access to the array of specialised equipment and central facilities HRD programmes
- Corporate membership of FITT
- Facilitate funding for development of innovative ideas of commercial implications

With strong support from the government, FITT has established **Incubation Centres** such as **TBI, Biotech Incubation Facility, Science and Technology Parks**. FITT has been a huge success in terms of I-A collaborative project which has generated ₹ 52 crores of assets since last 5 years. There are more than 64 corporate clients who avail corporate membership of FITT and draw mutual benefits from the services that FITT offers and in return contributed to ~ ₹ 17 lakhs of FITT earnings. Further, >46 companies are presently incubated in FITT that has potential to become successful ventures.

FITT works towards bringing the research outputs of the scientific community to the market by way of patenting their innovative research and preparing a business model for their applied research.

**c) Airtel IIT Delhi Centre of Excellence in Telecommunications (AICET):**

Collaboration between DoT, GoI, IIT-D and Bharti Airtel Ltd. (tri-partite MoU), lead to the establishment of AICET at IIT-D. This centre mainly focuses on ‘Telecom technology and management’ and is a part of the Bharti School of Telecommunication Technology and Management, which was set up at IIT-D in 2000. It aims to generate technology that is at par with the world standards thereby evolving India into a global leader in the area of telecom.

<b>Examples of a few technologies developed by IIT-D in 2015-16</b>	
<b>S. No.</b>	<b>Technologies Developed</b>
1.	Dual functionalized redox sensitive biodegradable polymeric nanosystems for targeted drug delivery in cancer therapy

2.	Piezo-based foot pressure sensor
3.	Nanopatterned cadmium selenide langmuir-blodgett platform for leukemia detection
4.	Smart and innovative textile materials (SMITA)
5.	Limb immobilization device (LID)

*Source: <https://www.iitsystem.ac.in/>*

## **VI. Indian Institute of Technology, Guwahati (IIT-G)**

*(<http://www.iitg.ac.in/>)*

**Introduction:** IIT-G was established on September 1<sup>st</sup> 1994 and its academic programme commenced in 1995. IIT-G is the sixth member in the IIT fraternity and within a brief span of time it has evolved and built up a world class infrastructure for advanced scientific R&D activities. Research is an integral part of the academic activities at IIT-G. The sponsored research has helped to bridge the gap between the academia and industry, added to the infrastructure of the institute and acted as training ground for young researchers. The R&D Office is the wing of the institute which facilitates, channelizes, records, and regulates all the funded research projects and consultancy works. During the academic year 2014-15, the institute published 1250 research publications and total R&D funding received during the same time period was ₹ 73.95 crores. IIT-G has filed 37 patents (2010-15), of which six were granted. A revenue of ₹ 1 crore has been generated from the six technologies that have been transferred till date and five technologies are available with the institute for transfer. With over 50 corporate clients and close to 10 industrial collaborations, IIT-G has earned ₹ 220 crores from various sponsored projects and ~ ₹ 16 crores from consultancy projects. 10 start-ups have evolved from the institute and there are 13 incubating companies presently.

### ***Industry Related Programmes***

- a) **IITG-Technology Incubation Centre (IITG-TIC):** In order to strengthen technology commercialization and entrepreneurship, IIT-G has established IITG-TIC (<http://www.iitg.ac.in/tic/home.html>) as a society under the Registration of Societies Act XXI of 1860. Its main objective is to back the entrepreneurial efforts amongst the faculty and alumni of the IIT-G. IITG-TIC provides a platform to explore and implement the innovative ideas into a commercially viable product through

technology start-up companies. This centre facilitates interdisciplinary research with special emphasis on development and innovation of high-growth knowledge-based-business and nurtures the indigenous products with innovative hardware/embedded designs. The centre offers technical support, business mentoring and soft loan facility. IITG-TIC also possesses one of the **Business Incubators** approved and recognized by the Ministry of MSME. The TDB, GoI, has also approved grant assistance to IITG-TIC to support start-ups units.

- b) **The Rural Technology Action Group, North-East (RuTAG-NE):** The RuTAG-NE (<http://www.iitg.ernet.in/mech/Rutag-pal/about1.htm>) was established in 2006. The main objective of this centre is to modify and enhance the systems/technologies that have been developed and are functioning, to a better level of functioning, by means of S&T. For example: the process of production of Eri Silk, traditionally is very laborious and lengthy, for which, RuTAG-NE has developed a machine that has the ability to complete a day's work in an hour. This centre has also successfully established a pilot plant for the production of Muga Silk. RuTAG-NE is responsible for developing quite a few accessory machines such as Hank to Bobbin Winding Machine and Sectional Warping Machine etc. The cost of these machines is lower as compared to their cost in the market. RuTAG-NE has also been training group of women from an NGO for the production of cost effective necessities.

In the academic year 2014-15, a technology '*Grating array based zonal wavefront sensor board setup*' was developed at the institute.

## **VII. Indian Institute of Technology, Roorkee (IIT-R)**

*(<http://www.iitr.ac.in/>)*

**Introduction:** The College at Roorkee was established in 1847 AD and was the first engineering college in the British Empire. It attained the status of a University under the Act No. IX of 1948 of the United Province (Uttar Pradesh). In 1949, Pt. Nehru elevated the status to the First Engineering University of Independent India, through a Charter. The Roorkee University was declared as an institute of national importance, with the passing of a bill in the parliament, on September 21<sup>st</sup> 2001 and was then renamed to Indian Institute of Technology

Roorkee (IIT-R). In the year 2014-15, IIT-R has 1209 publications to its credit and generated a revenue of ₹ 38.05 crores through industrial consultancy in the same year.

### ***Industry Related Programmes***

**a) Sponsored Research and Industrial Consultancy (SRIC)**

(<http://www.iitr.ac.in/research/pages/SRIC.html>): IIT-R recognizes the importance of the teamwork of education with research and industrial consultancies. Under the Dean, an office of SRIC operates, that caters towards providing organizational and accounting support to the members of the faculty that are performing sponsored research and industrial consultancy work. The centre also offers backing/support by working in closely with the private sector and government organizations and facilitating IP protocols.

Some examples of industrial consultancy are:

- Development of industrial projects/systems/processes
- Development of laboratories
- Testing of industrial products/samples
- Development and application of information technology
- Pre-feasibility and feasibility studies

**b) The Entrepreneurship Development Cell (EDC)** (<http://edciitr.com/>): The EDC of

IIT-R, was set up to encourage entrepreneurial activities among the scholars of IIT-R and to foster the spirit of creativeness and innovation. Initiatives taken by EDC, cell are:

- Endeavour entrepreneurship
- E-Club to overcome problems of students
- Start-up internship programme to lessen the gap amongst the students and the start-up ecosystem
- An online database of start-ups ([startups.edciitr.com](http://startups.edciitr.com)) of students and alumni of IIT-R
- PrernaYatra which is an entrepreneurial journey organized by EDC IIT-R.
- Incubate which is a B-Plan competition organized by TIDES Centre



- c) **Intellectual Property Right Cell** (<http://www.iitr.ac.in/ipr/index.html>): IIT-R has also created a cell to generate alertness and administer guidance to staff, students and outside agencies. This IPR cell contributes by equipping every one of the practices and the rules of institute regarding IPR and the obligations to be followed in course with the IPR policy of the institute. DST started a programme known as "Technopreneur Promotion Programme" (TePP) in 1998-1999 to promote and support the creative intellect of innovators of the country and to assist technopreneur in developing linkages with organizations. Outreach centres of TePP, known as TePP Outreach Centre (TUC), have been opened in different parts of the country and also at IIT-R.
- d) **RailTel IITR Centre of Excellence in Telecom (RICET)**: This CoE was established by DoT in association with RailTel and IIT-R to work in the area of 'ICT and Broadband Applications'. The main objectives of this centre include developing applications that are specific to the needs of India and therefore will add value to the economic and social activities of the citizens. These CoE also aim to generate market ready workforce and continuously upgrade the technical know-how in their domains.
- e) **Continuing Education Centre**: The Centre conducts 60 to 70 short term training programmes for personals of the industrial sector and govt./semi govt. organizations and public undertakings, research institutions and industries.

<b>Examples of a technology developed and patent by IIT-R in 2015-16</b>		
<b>S. No.</b>	<b>Technology Developed</b>	
1.	ED cell/ CD cell with membrane for zero discharge of waste water	
<b>S. No.</b>	<b>Patent</b>	<b>Application Number</b>
1.	A novel fractionating hydrolysis process for production of fermentable sugars from lignocellulosic biomass of kans grass ( <i>Saccharum spontaneum</i> )	201611005358 Dt 16.2.2016

Source: <https://www.iitsystem.ac.in/>

## VIII. Indian Institute of Technology, Bhubaneswar (IIT-BBS)

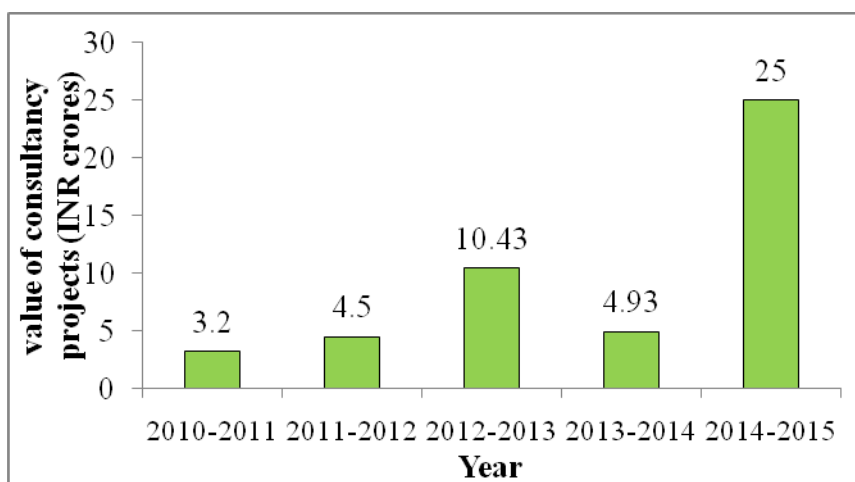
(<http://www.iitbbs.ac.in/>)

**Introduction:** IIT-BBS was established in 2008 from the campus of its mentor institute IIT-KGP and in 2009 it commenced its operation from the city of Bhubaneswar. The institute has been undertaking a number of research projects from funding organizations like DST, CSIR, DRDO, NIC and ISRO and consultancies to industries. Till now the institute has published ~ 1000 research publications and has filed 12 patents. Industries like M/s MGM Minerals Group have helped the institute develop, by establishing “MGM Chair Professor” in the School of Minerals, Metallurgical and Materials Engineering with an endowment of ₹ 300 lakhs.

### *Industry Related Programmes*

- a) **Sponsored Research and Industrial Consultancy (SRIC) Cell** (<http://www.iitbbs.ac.in/sric-application/>): SRIC coordinates all sponsored research and consultancy projects. MoUs have been signed with various industrial collaborators such as the MGM Minerals Group to work in areas of common interest. A large number of research projects along with industrial consultancy projects are carried out independently in each school though IIT-BBS does not have any dedicated cell for I-A activities. From 2010-2015 IIT-BBS has carried out 170 sponsored projects, mainly government funded and 41 industrial consultancy projects.

Since 2010, industry has actively collaborated with the institute by means of consultancy and has contributed to more than ₹ 48 crores of revenue (Fig. 8).



**Figure 8: Value of Consultancy Projects Undertaken by IIT-BBS**

Source: IIT-BBS Annual Report 2014-15

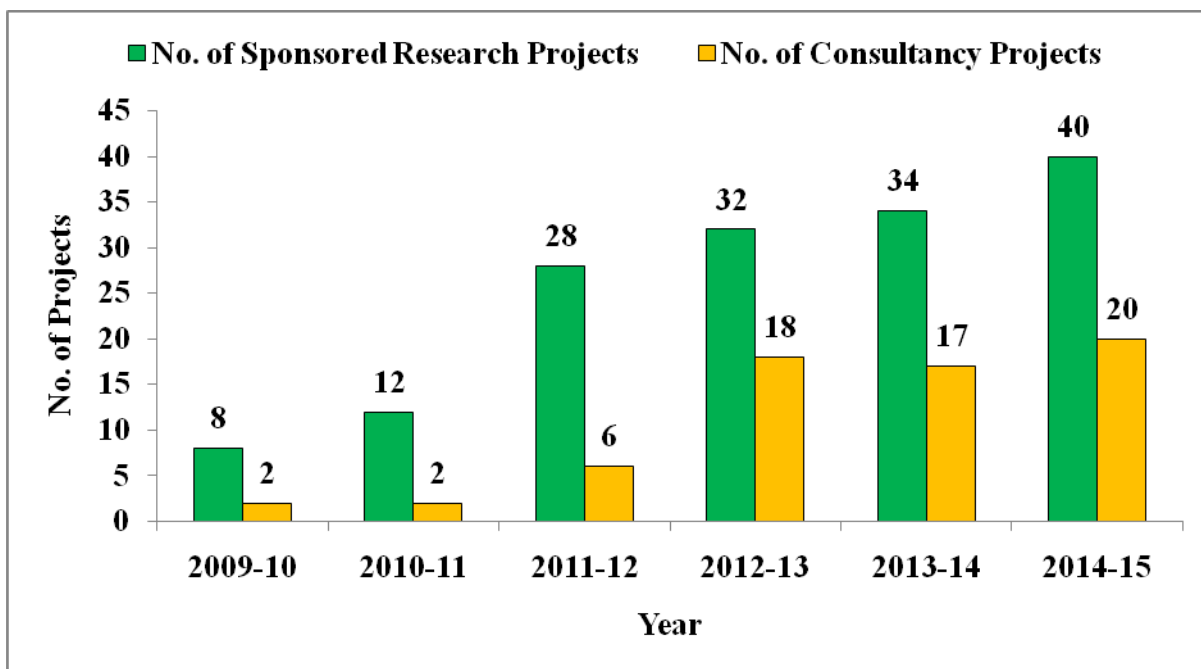
<b>Examples of a few technologies developed and MoU signed by IIT-BBS in 2015-16</b>		
<b>S. No.</b>	<b>Technologies Developed</b>	
1.	Verification of virtual live migration between data centres in cloud	
2.	Fuel for all: Optimization of indian LPG cylinder distribution system	
3.	A thousand eyes: Ensuring a safer world through a vehicle mounted surveillance system	
4.	Development of structural lightweight concrete using sintered flash aggregate	
5.	Development of an integrated zero energy modular system for the treatment of rural domestic wastewater: emphasis on nutrient removal	
<b>S. No.</b>	<b>MoU with Industry</b>	<b>Signed with</b>
1.	Advanced research laboratory on big data analytics	Affine Analytics Private Ltd.

*Source: <https://www.iitsystem.ac.in/>*

## **IX. Indian Institute of Technology, Hyderabad (IIT-H)**

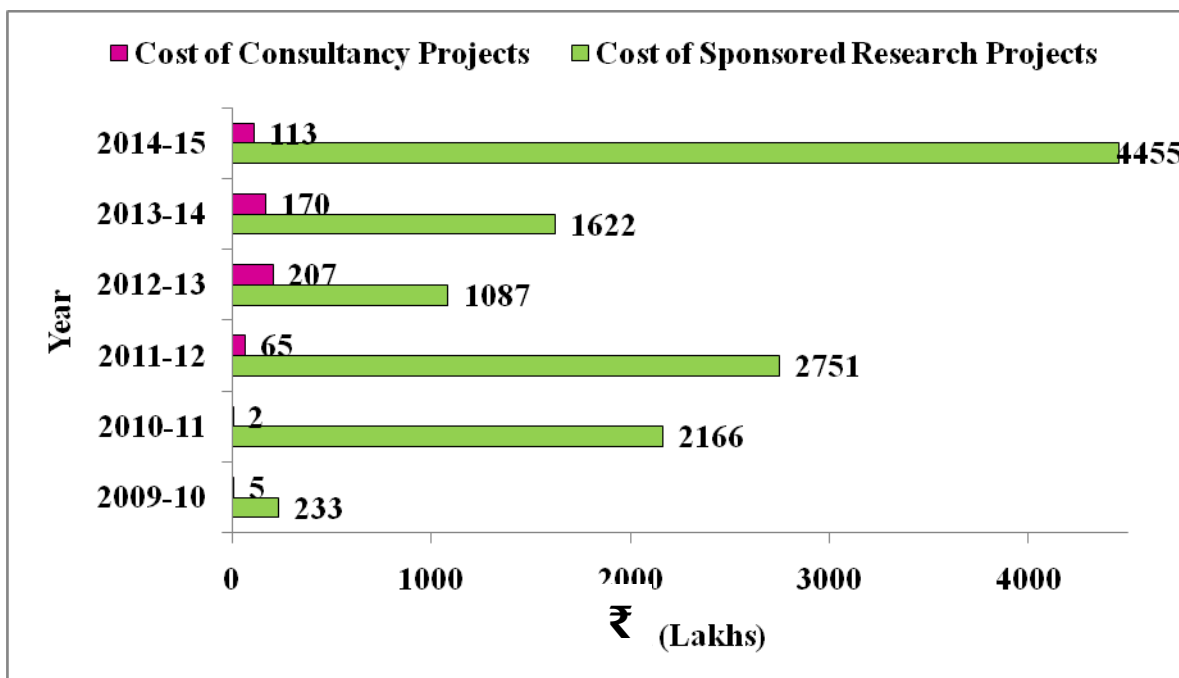
*(<http://www.iith.ac.in/>)*

**Introduction:** IIT-H was found in 2008 at a makeshift campus in ordinance factory in Medak district and in 2009 shifted to its main campus in Kandi. IIT-M acted as mentor institute for IIT-H by supporting it at various levels. IIT-H today boasts of around 1850 students, 145 faculty members and 14 academic departments covering areas of engineering, sciences, liberal arts and design. The scientific staff and the disciples of the institute are at the forefront of academic innovations and innovative research. IIT-H has had approx. 930 publications, 15 patents filed and close to 230 sponsored research and consultancy projects (Annual Report 2014-15). IIT-H has tie-ups with industrial giants who provide the students scholarships and research internships.



**Figure 9 (A): Number of Sponsored Research and Consultancy Projects Undertaken by IIT-H**

*Source: IIT-H Annual report 2014-15*



**Figure 9 (B): Cost (₹ Lakhs) of Sponsored Research and Consultancy Projects Undertaken by IIT-H**

*Source: IIT-H Annual report 2014-15*

IIT-H has established collaboration with various industries located in and around Hyderabad. Mainly the institute offer consultancy to the industries. IIT-H has undertaken more than 45

industry consultancy projects. Figure 9 (A & B) shows the trend in sponsored and consultancy projects undertaken by IIT-H, 2010 onwards. Over 100 sponsored projects from national funding agencies and private companies have been undertaken by the institute. IIT-H is in association with ~100 companies and is on the way to establish strong I-A interface in coming years.

Recently, the institute launched its **Technology Business Incubator** to promote entrepreneurial culture. The incubator has incubated 4 companies. In IIT-H, **TEQIP** has also been set up to aid transformation in technical education system with support from World Bank. IIT-H is associated with **Unnat Bharat Abhiyan** and working for rural development by producing technologies for accelerating growth in rural areas.

### ***Industry Related Programmes***

- a) **Center for Healthcare Entrepreneurship:** This center was inaugurated in the year 2015 and is sponsored by two entrepreneurs (IIT Bombay alumni) from the Silicon Valley. This center aims towards innovative, affordable healthcare solutions for addressing the needs of India’s population, particularly the underserved. The centre identifies and groom innovators, mentor them to the level of production, scale up and eventually societal adoption of the technology/ product and its impact.
  
- b) **Entrepreneurship Cell (E-Cell):** The E-Cell at IIT-H is a student run body that aims to foster entrepreneurial temper amongst the students of the institute. The cell supports the innovative streak in the students by providing them with resources, networking, guidance and motivation. Various events hosted by the cell include idea to business workshops, lecture series (by entrepreneurs from all over the country) and prototyping events.

<b>Examples of a few technologies developed and patents by IIT-H in 2015-16</b>		
<b>S. No.</b>	<b>Technologies developed</b>	
1.	Earthquake disaster management system	
2.	Snake robot for search and rescue missions	
<b>S. No.</b>	<b>Patents</b>	<b>Application Number</b>
1.	Silver nanoparticle array sandwiched multilayer thin film amorphous silicon photovoltaic device	

2.	An apparatus for measuring transverse pullout resistance of a reinforcing element and method thereof	CHE/2015
3.	Lateral reinforcement system and method for concrete structures	3001/CHE/2015

*Source: <https://www.iitsystem.ac.in/>*

## **X. Indian Institute of Technology, Gandhinagar (IIT-GN)** (<http://www.iitgn.ac.in/>)

**Introduction:** IIT-GN was founded in 2008 and is located in Ahmedabad (Gujarat). The institute is strongly working to attract industries for carrying out research and consultancy projects. For industrial outreach it has started industry open house and industry partnership retreat where more than 50 industries from all over India. The institute has explored the areas where industries can partner with the institute and has partnered with >25 industrialists for carrying out research in various domains. These events showcase expertise, infrastructure capabilities of institute that can be availed by industrial sector. Till now, the institute has undertaken 54 sponsored research projects and 23 consultancy projects from government and industrial collaborators. Till date it has filled 8 patents and ~1266 publications.

### ***Industry Related Programmes***

- a) **Incubation Centre (IIC):** It has been established to promote innovation and entrepreneurship. In 2012, the institute received TIDE grant from MeitY to enable creation of incubator. IIC is well connected with ecosystem partners and incubators in Ahmedabad. It contains one non-resident and 2 resident incubatees. The institute has launched a deferred placement policy in 2014 for enabling students to opt out of placement and pursue their entrepreneurship dreams.
  
- b) **Innovation and Entrepreneurship Centre (IIEC) and Technology Business Incubator** (under aegis of DST) were established to support incubation and technology commercialization is under progress. IIT-GN has also launched **Women in Start-ups (WINS)** an initiative for fostering techno-entrepreneurship skills among women.

- c) The institute has community outreach programme namely **Nurture and Empower Entrepreneurial Ventures (NEEV)** to promote growth of entrepreneurship through training, mentoring and networking opportunities.

<b>Examples of a few technologies developed and MoUs signed by IIT-GN in 2015-16</b>		
<b>S. No.</b>	<b>Technologies developed</b>	<b>Year</b>
1.	Smart eye	2015-16
2.	One touch doctor	2015-16
<b>S. No.</b>	<b>MoUs with the Industries</b>	<b>Signed with</b>
1.	To encourage collaborative research with leading industries around the globe for providing technological innovation	KHS Machinery Private Limited, Ahmedabad
2.	Analog lab setup	M/s EdGate Technologies Pvt. Limited, University Program partner of Texas Instruments, India
3.	To organize a program for academic cooperation in areas of mutual interest	Xylem Water Solutions India Private Limited, Vadodara, Gujarat
4.	To promote collaboration between industry and academia for joint research and development of bio-medical information processing/instruments, healthcare/lifestyle products and security systems.	Pracsol Health India Private Limited (PHIPL)
5.	Analog teaching lab setup	Cranes Software International Limited
6.	For intensifying academic cooperation	Tata Consultancy Services Limited

*Source: <https://www.iitsystem.ac.in/>*

## **XI. Indian Institute of Technology, Patna (IIT-P)**

*(<http://www.iitp.ac.in/>)*

**Introduction:** IIT-P was established on August 06, 2008. Initially the institute was under the mentorship of IIT-G. The institute has now carved a niche in the domains of education, inquests and research. It has ten academic departments with student strength of 670 in the undergraduate courses, 160 in postgraduate courses and 250 in the doctoral program. The institute has been growing steadily with the increase in number of faculty members to 101

and a non teaching staff of 70 members. In the year 2014-15, the institute published nearly 75 research publications.

### ***Industry Related Programmes***

- a) **Sponsored Research and Industrial Relations Unit (SRIRU)** (<http://www.iitp.ac.in/index.php/research/r-and-home.html>): IIT-P considers the need to facilitate R&D efforts in a disciplined manner to ensure a strong base and growth in research by generating resources, effective collaborations and links with the private sector. SRIRU, established in 2009, is a special unit set up to act as an a unit to coalesce the funding agencies and IIT-P for handling the industrially sponsored research and consultancy works. SRIRU handles the directorial and logistics aspects related to recruitments, accounts, audits, liaisons with sponsors, and prepare the status reports.
  
- b) IIT-P has also set up an **Incubation Centre (IC)** in the area of Electronic System Design & Manufacturing with focus on Medical Electronics. This is funded by MeitY & Bihar State Government. IC focuses on developing products for commercial exploitation via the route of physical infrastructure, technical expertise and networking support to new enterprises with innovative technologies.
  
- c) **Entrepreneurship Club** (<http://www.iitp.ac.in/ecelliitp/>): This club is established by the students of IIT-P with the goal of forming a common point for the aspiring entrepreneurs at the institute. The students aim to foster an environment that would empower aspiring students by coordinating with successful entrepreneurs who have undertaken this path. Various lectures and workshops on business topics are held, successful entrepreneurs and industry leaders are invited for business talks and speeches. This plan has been devised by the students to promote entrepreneurship within the IIT-P community.
  
- d) IIT-P has also taken initiative in curriculum development for the industry. The institute offers post graduate courses for industry personnel.



<b>Examples of a few patents and MoUs signed by IIT-P in 2015-16</b>		
<b>S. No.</b>	<b>Patents</b>	<b>Application Number</b>
1.	Automatic booklet scanning machine (ABSM)	Indian Patent Application No. 1082/KOL/2015
2.	New design application - Handle operated garbage & soil Collector	Indian Design Application No :272013/D/NF/SKM
<b>S. No.</b>	<b>MoUs with the Industries</b>	<b>Signed with</b>
1.	Centre of excellence of natural language processing	Reed Elsevier India Private Limited
2.	Research on NLP and machine learning	Process Nine Technologies Pvt. Ltd, Gurgaon
3.	EzDI research lab of health informatics	Mediascribes Solutions (India) Pvt. Ltd.

*Source: <https://www.iitsystem.ac.in/>*

## **XII. Indian Institute of Technology, Jodhpur (IIT-J)**

*(<http://www.iitj.ac.in/>)*

**Introduction:** The MHRD announced the establishment of eight new IITs in the country on March 28<sup>th</sup> 2008. IIT-J (formerly known as IIT Rajasthan), was one of them. The institute has collaborations with Microsoft R&D, IBM, and TCS. Representatives from top industries pay regular visits to the department for delivering seminars, conducting workshops.

### ***Industry Related Programmes***

- a) IIT-J has a well placed **Office of R&D**, which is responsible for organizational and directorial support for sponsored research projects, industrial consultancies and other R&D activities of IIT-J. It facilitates and promotes collaborations between the industry and academia, and the liaisons between the institute and various funding agencies. This office also carries the responsibility of facilitating documentation of the intellectual property of the institute and filing of patents. The office runs the interface for:
- Management of projects (sponsored, consultancy & other research projects).
  - Management of office – Publishing of R&D newsletters, research magazine of the institute, developing a database of R&D contacts in industry, academia and other organizations (national and international).

- It also manages the MoUs, IPRs and other corporate communications of the institute.
- Industry liaisons are also held with the Office of R&D. All the interactions with the industry, industrial R&D, consultancy, extension services, technology transfers, industry internship for faculty mainly are looked after by the Office of R&D.

b) **Entrepreneurship Cell** (<http://iitjecell.in/index.html>): IIT-J has started an entrepreneurship cell to develop the entrepreneurial mindset in aspiring entrepreneurs. Organizing the start-up visits and conducting case studies on successful start-ups are main events organized by this cell.

c) **Blended Technical Education Program:** IIT-J is initiating to collaborate with industries towards enhancing the learning experience of students and faculty members. The thought behind the Blended Technical Education Program was to inspire the students to help solve the obstacles of the Indian industry. The aegis of the program desired to have industry captains lay a framework by giving a real life picture of sectoral technologies, needs of the industry, challenges and research opportunities. The program encompasses other programs such as:

- **Vanguard Lectures**-The Vanguard Lecture Series form an integral part of Blended B. Tech. Program. These lecture series enable the students to get a know-how of the industrial ecosystem and deeper insights in the technological areas, by listening to talks given by distinguished experts from the industry and academia. The first phase of the program began in July 2014, and since then it has witnessed two successful series of vanguard lectures delivered by the domain experts from industry and academia.
- **Industry Immersion Program (IIP)**-The Institute has signed MoUs with leading Indian industries to strengthen its undergraduate technical education. Currently, five industry partners have joined the IIP, namely: (1) Mahindra & Mahindra Limited, Mumbai; (2) Larsen & Toubro Limited, Mumbai; (3) Tata Motors Limited, Mumbai; (4) TVS Motor Company Limited, Chennai; and (5) Tata Power Limited, Mumbai. The IIP is an impressive module that focuses on learning by doing, working on live assignments under the mentorship of

industry professionals, engaging in industry linked projects (starting in fourth semester of B. Tech). This program will also help the faculty members by broadening their horizon and giving them the ability to look beyond the institute for developing relations with the industry. A precedent of the same is an MoU signed between the institute and TVS Motor Company, Chennai. It is aimed at expanding I-A collaboration by giving the faculty and students of the institute an experience of the industry experience and in turn, the professionals of TVS can get academic experience.

<b>Example of a technology developed and a patent by IIT-J in 2015-16</b>		
<b>S. No.</b>	<b>Technology Developed</b>	
1.	Open volumetric air receiver (OVAR)	
<b>S. No.</b>	<b>Patent</b>	<b>Application Number</b>
1.	A black chromium coating bath	1433/DEL/2013

*Source: <https://www.iitsystem.ac.in/>*

### **XIII. Indian Institute of Technology, Ropar (IIT-RPR)**

*(<http://www.iitrpr.ac.in/>)*

**Introduction:** IIT-RPR was established in 2008 by the MHRD under the mentorship of IIT Delhi. The institute of national importance is located at Rupnagar in the state of Punjab. The institute in its endeavour to live up to the status and brand name created by its predecessors is keen to establish a robust academic environment along with facilitating cutting edge R&D. The faculty at IIT-RPR is encouraged to initiate research work and are also provided with facilities/initial grants to sustain research work. The institute pushed the faculty to perform collaborative research with other research labs and also with the industry. The institute has a number of consultancy projects to its credit. IIT-RPR is soon going to establish a Central Research Facility to amplify its research activities. The institute has set up dedicated cells to strengthen and reinforce the spirit of innovation and entrepreneurship amongst its faculty and students.

#### ***Industry Related Programmes***

- a) **Prototype Development and Innovation Fund (Entrepreneurship Cell):** This initiative was set up in collaboration with the Punjab Technical University, to foster

innovation within various domains of knowledge and technology development. It aims to work towards finding innovative solutions for industrial and societal concerns that are critical to the world. This fund was established to address the gap between research laboratories and the market. It funds projects that are commercially viable and have the potential to serve the technological needs of the nation.

**b) Intellectual Property Rights (IPR) Cell:** The Patent Information Centre (PIC) of the Punjab State Council for Science & Technology has set up an IPR Cell at IIT-RPR to provide IPRs protection information and patenting facilities to the institutes faculty and students. The cell is responsible for all activities related to patenting and technology transfers to the industry.

**c) Technology Business Incubator (TBI):** The institute has received a grant of ₹ 500 lakhs to set up a TBI in Punjab. This grant shall be devoted towards the central government's "Start-Up India Programme". The incubator will foster innovation and entrepreneurship ecosystem. TBI will provide various facilities like mentoring, physical office space, library and equipments among other things. Key focus will also be on providing networking and marketing support to all incubatees in order to enable and prepare them to raise capital through angel funding. The TBI, with specialized *state of art* facility will focus on providing the incubatees unlimited access to the skilled resources in the field of S&T, in order to help them grow. The main objectives of this incubator are:

- To promote new technology/knowledge/innovation based startups.
- To build a vibrant startup ecosystem, by establishing a network between academia, financial institutions, industries and other institutions.
- To provide cost effective, value added services to startups like mentoring, legal, financial, technical, intellectual property related services.
- To provide a platform for speedy commercialization of technologies developed by the host institution or by any academic/technical/R&D institution or by an individual.
- To create jobs, wealth and business in alignment with national priorities.

- d) IIT-RPR has a **Centre for Innovation & Business Incubation (CIBI)**, which provides incubation services for start-ups with a technology and knowledge base. Established in 2013, this center focuses on accelerating innovation, business incubation and growth of entrepreneurship at IIT-RPR. The objective of CIBI is to facilitate the ‘conversion of research activity into entrepreneurial ventures’. It has received financial assistance from various sources along with from DST, GoI. The institute is supporting four start-ups, at the moment.

#### **XIV. Indian Institute of Technology, Indore (IIT-I)**

*(<http://www.iiti.ac.in/>)*

**Introduction:** The institution was set up in 2009. IIT-I through its endeavours has attained international importance and recognition. The institute has been a participant in several projects of international repute and also is in partnership with different research organizations. IIT-I has gained recognition due to its collaborative research efforts with agencies from many foreign countries like USA, France, S. Korea, Japan, Germany, Portugal etc. The institute has generated a net worth close to ₹ 22 crores through approximately 82 sponsored projects.

##### ***Industry Related Programmes***

- a) **Innovation and Entrepreneurship Development Centre (IEDC):** This centre was funded by DST, with a purpose to foster an environment of innovation and entrepreneurship. This centre has supported the on campus student activities by setting up **Student Entrepreneurship Support Cell (SESC)**. SESC has been proactively generating awareness amongst the pupils through the means of events and workshops and bolstering them for entrepreneurial efforts. In a time span of six months, since the initiation of this cell it conducted nearly 50 events and also bagged the 2<sup>nd</sup> position at National Entrepreneurship Challenge organized by IIT Bombay in Feb, 2014 and Best Debutant Award in E-Week in March 2014, organized by National Entrepreneurship Network. IIT-I students are charged and are in the process of initiating their entrepreneurial ventures thereby applying their innovative ideas into practical applications.

- b) To develop linkages with the private sector and to cater to their needs of enhancing their academic qualifications, IIT-I has initiated **Continuing Education Programmes (CEPs)** and ‘Short Courses’ for working professionals in industry, institutions and other organizations across India. These courses enable them to update their knowledge and skills, and also to train them in *state of art* facilities.

<b>Examples of a few patents and MoU signed by IIT-I in 2015-16</b>		
<b>S. No.</b>	<b>Patents</b>	<b>Application No.</b>
1.	Method device and apparatus for managing phone/device Profile based on an event	3415/MUM/2015
<b>S. No.</b>	<b>MoUs with the Industries</b>	<b>Signed with</b>
1.	Technical mentoring of the students at IIT Indore	IBM India Private Limited
2.	Training programs for the life sciences student community	Wipro GE Healthcare Pvt. Ltd., Bangalore

Source: <https://www.iitsystem.ac.in/>

## **XV. Indian Institute of Technology, Mandi (IIT-MN)**

(<http://www.iitmandi.ac.in/>)

**Introduction:** IIT-MN is an autonomous premier engineering institute located in Himachal Pradesh, which was established in 2012, in association with IIT Roorkee.

The institute encourages linkages with the industry and the students are required to undergo industrial training. The **Career and Placement Cell** at the institute facilitates the internship of the students at various reputed industries.

<b>Example of a technology developed and MoU signed by IIT-Mandi in 2015-16</b>		
<b>S. No.</b>	<b>Technology Developed</b>	
1.	Interactive landslide simulator for risk communication against landslides ( <a href="http://pratik.acslab.org/">http://pratik.acslab.org/</a> )	
<b>S. No.</b>	<b>MoU with the Industries</b>	<b>Signed with</b>
1.	TCS research scholar program	Tata Consultancy Services Limited

Source: <https://www.iitsystem.ac.in/>

## XVI. Indian Institute of Technology, BHU [IIT(BHU)]

(<http://www.iitbhu.ac.in/>)

**Introduction:** The Institute of Technology, Banaras Hindu University (IT-BHU), was converted into Indian Institute of Technology (Banaras Hindu University), Varanasi by the Government of India, New Delhi on 29th June, 2012. The institute gives due importance to links with the industry and it is mandatory for students to undergo industrial internship which is facilitated by the **Training and Placement Cell**. The campus placements of the students in various industries are also looked after by the cell. Soft skill development programmes to make the students industry ready are undertaken by the cell. To inculcate the spirit of innovation and creation of entrepreneurs the institute has set up a dedicated cell.

### *Industry Related Programmes*

- a) **Malaviya Centre for Innovation, Incubation and Entrepreneurship (MCIE):** All the industrial and societal activities of IIT(BHU) are being coordinated by MCIE. This centre is also registered as a separate society. This centre was set up with a dedication to promote innovation and entrepreneurship. The centre aids the guidance of knowledge driven enterprises and facilitates the commercialization of a product. This centre fosters the establishment of newer firms that create jobs, commercialize novel technologies thereby strengthening the national economy.

Examples of a few technologies developed and patents by IIT(BHU) in 2015-16		
S. No.	Technologies Developed	
1.	Synthesis of water based adhesives ( <a href="http://www.shrimalibond.com">http://www.shrimalibond.com</a> )	
2.	Extraction of silica from rice husk ash ( <a href="http://www.bridgedots.com/">http://www.bridgedots.com/</a> )	
3.	Reverse osmosis based potable water system with improved yield ( <a href="http://www.aquvio.com/">http://www.aquvio.com/</a> )	
S. No.	Patents	Application Number
1.	Application of grafted amylopectin for waste water treatment	60/Cal/2001
2.	An innovative polyherbal bioabsorbable dermal patch for wound healing	2087/DEL/2015
3.	A novel polyherbal formulation for growing adolescent girl and process for its preparation	736/DEL/2015
4.	A novel polyherbal formulation for reduction in obesity and process for its preparation	735/DEL/2015

5.	An improved caving longwall method for winning of coal from thick seam in single life under massive and hard roof conditions in underground mines	212/DEL/2002
6.	Device for sealing inside an upward drilled borehole for high pressure water injection in underground mines	855/DEL/2001

*Source: <https://www.iitsystem.ac.in/>*

### 3. Summary

- IITs not only impart top class teaching but also carry out globally competitive R&D in the domains of engineering and biotechnology. Industry-Academia (I-A) engagements are the highlight of all IITs.
- Each new IIT is being mentored by one of the first generation IITs e.g. IIT-H and IIT-RPR are being mentored by IIT-M and IIT-D respectively.
- IIT-KGP leads all IITs in the parameter of *publications* (2162) in the time period 2014-15. IIT-B (~1500), IIT-D (1300) and IIT-K (1298) occupy second, third and fourth position respectively. IIT-KGP also leads in the number of Incubating Companies (172), followed by IIT-M (95) and IIT-B (71).
- IIT-B leads in the following parameters: *Patents filed* (569) and *granted* (>61) in the period 2010-15), *Technologies available* (409) and *licensed* till date (>140), and *industrial collaborations* (225) in the time period 2010-15.
- First generation IITs have been generating large amount of revenues through their linkages with the industrial sector by means of sponsored projects and consultancy projects. IIT-M ranks number one amongst all IITs in, *Revenue generated through tech transfers* (₹ 461 crores) till 2015 and *Consultancies* (₹ 251 crores).
- A vibrant *I-A interface* is present in IITs e.g. *SRIC* at IIT-KGP, IIT-R, IIT BBS, *IRCC* at IIT-B, *IC&SR* at IIT-M, *SIIC* at IIT-K, *IRD* at IIT-D and *SRIRU* at IIT-P. This interface manages the industrial relations of the institute and monitors the R&D activities being performed at respective IITs.
- To protect and promote the intellectual property (IP) of the institute, nearly all IITs have set up dedicated *IPR Management Cells*.
- To encourage the spirit of entrepreneurship and start-ups, most IITs, such as IIT-KGP, IIT-B, IIT-M, IIT-R, IIT-H, IIT-GN, IIT-P, IIT-J, IIT-I, IIT(BHU) have established *Entrepreneurship Cells*.



- A few IITs, namely IIT-KGP, IIT-D, IIT-M, IIT-G, IIT-H, IIT-GN and IIT-RPR. have established *Technology Business Incubators* (TBIs) to nurture technology and knowledge based enterprises and assist them during their start up period, which is close to three years. TBIs offer space, services, technical assistance, legal assistance, networking support, access to infrastructure and equipment, financial support, as well as assistance in the development of business plans.
- A few IITs like IIT-KGP, IIT-M, IIT-B have come up with *Research Parks* which aim to create an environment for innovation and entrepreneurship.
- The IITs have also been working towards dispersing knowledge to the society outside. Barring a few, IITs have *Continuing Education Programme (CEP)* for the industry personals. IIT-D also offers a special *Professional Candidate Registration (PCR) Programme*, and IIT-RPR offers *Part-time Ph.D. for industry personals*.

#### **4. Conclusions**

The ever thriving economy of India demands committed technical resources (manpower) and technology creators. This requires an environment conducive for fostering innovative intellect that is driven by the knowledge base. The IITs not only impart top class teaching but are also equally effective in converting their academic wealth into commercial success by means of patents, technology transfers etc. The presence of all components needed for translational research namely, I-A Cell, IP Cell, Entrepreneurship Cell, Centres of Excellence (R&D) is responsible for the success stories of technologies, products, patents and start-ups in the first generation IITs. Second generation IITs are in the process of developing infrastructure needed for translational research. Once it is in place, these IITs will also be a force to be reckoned with in the domains of publications, patents and technologies.

In India, majority of 700 universities and > 300 national research laboratories are devoid of value chain needed for converting scientific knowledge into innovative product. The establishment of such value chain in these institutes will certainly help in boosting the number of patents and technologies. Also, on the lines of having one older IIT mentoring a new IIT, universities having potential for generating IP can also be allocated one mentoring IIT.

## 5. References

- Annual reports of IIT Kharagpur, IIT Bombay, IIT Madras, IIT Kanpur, IIT Delhi, IIT Guwahati, IIT Roorkee, IIT Bhubaneswar, IIT Hyderabad, IIT Gandhinagar, IIT Patna, IIT Jodhpur, IIT Ropar, IIT Indore, IIT Mandi, IIT(BHU).
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## Addendum

### **Impacting Research Innovation and Technology (IMPRINT) India Initiative for IITs ([www.imprint-india.org](http://www.imprint-india.org))**

In order to attain economic prosperity and upliftment, emphasis of R&D needs to be directed on societal and economical challenges of the country. To address these challenges, in 2015 MHRD came out with an innovative programme i.e. IMPRINT\* India Initiative. This programme will cater to the challenges in science and engineering sector to enable, empower and embolden the nation for inclusive growth and societal development. The programme will be carried out by the scientific fraternity of sixteen IITs and IISc, Bangalore. Director of IIT Kanpur, Prof. Indranil Manna is heading IMPRINT India Initiative. IMPRINT has signed MoUs with 25 ministries to support them to carry forward research work carried out in IITs.

MHRD has identified 10 domains of societal importance, and the responsibility of accomplishing the objectives of these domains is vested upon five institutes as mentioned below.

<b>Institute</b>	<b>Domains<sup>#</sup> (10)</b>
<b>IIT Kharagpur</b>	<ul style="list-style-type: none"><li>• Information and Communication Technology</li><li>• Health Care</li></ul>
<b>IIT Bombay</b>	<ul style="list-style-type: none"><li>• Nano-technology Hardware</li><li>• Energy</li></ul>
<b>IIT Kanpur</b>	<ul style="list-style-type: none"><li>• Water Resources and River systems</li><li>• Advanced Materials</li></ul>
<b>IIT Madras</b>	<ul style="list-style-type: none"><li>• Manufacturing</li><li>• Security and Defense</li></ul>
<b>IIT Roorkee</b>	<ul style="list-style-type: none"><li>• Sustainable Habitat</li></ul>
<b>IISc Bangalore</b>	<ul style="list-style-type: none"><li>• Environmental Science and Climate Change</li></ul>

<sup>#</sup>Each domain is categorized into themes, sub-themes, target and topics for promoting research and innovation.

- IMPRINT is working with a task force to map the strength and weakness in Indian education system to champion the engineering targets.
- Under IMPRINT initiative, focus is on strengthening academia and industry linkages in order to create and sustain an inclusive scientific eco-system in society to develop novel goods and services to add both competitive and add value to serve the nation.

- Presently, IMPRINT is in its first phase which is focusing on creation of a policy document that will define the scope, mandate and strategy for pursuing engineering challenges in the country.
- Second phase of IMPRINT will focus on developing technological products/ processes through well developed innovation system for the societal need.